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Automatic Image Recognition by Coherent Image Techniques

25X1

Progress Report No. 5

Financial Status

Amount Authorized

Estimated expenditures through 6 June 1965

Funds Committed

Funds Remaining

Technical Status

The engineering progress report for the period

13 May to 12 June 1965 is attached.

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6/16/65

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DECLASSIFICATION

MATERIAL CONTAINS SEFCRIATION AFFECTING THE MATERIAL CONTAINS SECURITY OF THE UNITED STATES WITHIN THE MATERIAL CONTROL OF THE ESPIGNACE LAWS, TITLE 16, C.S.C., SECO. FOR AND 794, THE THEOREM OF REVELATION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROMOTED BY LAW.

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Automatic Image Recognition by Coherent Optical Techniques

Progress Report No. 5

Period Covered: May 13, 1965 to June 12, 1965

The project is progressing in accordance with the revised schedule. New completion date is September 12, 1965.

Experimental studies conducted during this reporting period include preliminary tests of the liquid gates for use on the 20-foot optical bench, vibration tests, multiple object filter tests.

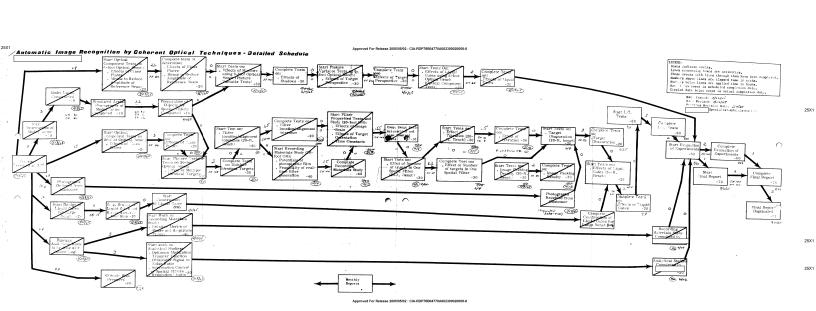
Preliminary tests on the liquid gates revealed that the gates operate properly until the liquid is added. After addition of the liquid, the gate develops an astigmatism which prevents proper focusing of the image. It is thought that temperature gradiants may be causing the problem. Various liquids will be investigated to try to get the gates operating properly.

The tests of multiple object filters will be repeated. Early tests were done with ten object filters, comparing the filter to all ten objects at the same time. It has been determined that a better method of testing is to check against one object at a time. Also, the tests to determine the optimum number of objects for vehicles will be repeated using the new testing procedure.

Vibration tests were conducted and revealed that the system will operate in the image recognition mode with rather severe vibration. The actual exposure time to produce a filter requires a vibration-free optical system.

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and	is	ready	for	inclu	sion	in	the	fin	а1	rep	ort.		-				•

During the next reporting period, it is planned to complete the multiple object filter tests, the tests of shadows and target perspective and start intensive work on target obscuration using aerial photographs. Investigation of the problems with liquid gates for 20-foot optical bench will be continued.



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Automatic Image Recognition by Coherent Image Techniques

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Progress Report No. 4

Financial Status

Amount Authorized

Estimated expenditures through 9 May 1965

Funds Committed

Funds Remaining

Technical Status

The engineering progress report for the period 13 April to 12 May 1965 is attached.

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Automatic Image Recognition by Coherent Optical Techniques

Progress Report No. 4

Period Covered: April 13, 1965 to May 12, 1965

The project completion date has been extended one month and the PERT diagram has been revised to reflect this change. New completion date is September 11, 1965. The work is progressing on schedule. A preliminary copy of as much of the report as is finished at this time has been submitted. This information is still subject to change and should be handled accordingly.

Experimental studies conducted during this reporting period include: continued work on effect of shadows and effect of image scale (1 mm objects), effect of number of targets in one spatial filter, and image packing density.

Curves were prepared of the effect of shadows using 1 mm objects. These curves now show a definite relationship between shadows and recognition. Earlier work in this investigation failed due to improperly photographed models.

Investigation of multiple object filters has revealed that all multiple object filters give weaker signals than single object filters. The alignment tolerances (x,y, rotation, and magnitification) become more critical. Because of the critical

alignment in rotation, the time to make a scan with a multiple object filter is longer than making individual scans with separate single object filters. multiple object filters will continue during the next reporting period. 25X1 has investigated the relative advantages and disadvantages of using glass plates or film for spatial filters. In all cases the film filters were better. Although scheduled to be completed later in the program, image packing density has been finished and reported. Optimum size appears to be 3 mm - 5 mm vehicles. This size, of course, is dependent on the "f" number of the readout system. 25X1 Reports covering six investigations have been submitted by completing the current work that has been outlined for him to do on the program. All these reports have been reviewed and edited and returned to for comment. 25X1

During the next reporting period work will continue on the effect of shadows using 1 mm objects and the effect of target perspective. Work on the effect of number of targets in one spatial filter and the effect of vibration will be completed and work will start on target obscuration.

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Automatic Image Recognition by Coherent Image Techniques

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Progress Report No. 3

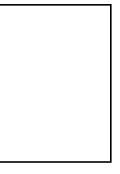
Financial Status

Amount Authorized

Estimated expenditures through 11 April 1965

Funds Committed

Funds Remaining



Technical Status

The engineering progress report for the period March 12 to April 12, 1965, is attached.

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Automatic Image Recognition by Coherent Optical Techniques

Progress Report No. 3

Period Covered: March 12 to April 12

Work has progressed in accordance to the PERT diagram submitted with Progress Report No. 1. We are essentially on schedule at this point in the work program. Work with small images on the 6-foot optical bench has fallen somewhat behind the dates on the diagram but this does not effect the overall schedule.

Experimental studies conducted during this reporting period include: effect of shadows, effect of image scale (1 mm objects), effect of alignment/tolerance, and filter properties tests and study.

Image recognition of 1 mm size objects was attained on the 6-foot optical

	recognition system. Additional microflat plates were prepared of 1 mm objects at different sun angles. Tests will be made on these plates to determine the effect of shadows.
25X1	has prepared a theory which will allow one to calculate the alignment/tolerance of almost any spatial filter. It was determined that when the filter position is within one mil off-axis, the signal will deteriorate to about 9/10 of its normal value.
	In filter properties tests, the effects of variation in target orientation and the effects of time constants were studied. For all different shaped objects, the shape of the curve on variation in orientation is the same. In the case of every object, when rotated 1°, the signal fell off to 95 - 96%. The rotation can drop down to about 6° or 7° before it has a serious effect on the signal.
	In addition to these experimental studies, submitted three reports 25X1 on analytical studies he is conducting:
25X1	 Information Content of Spatial Filters. Optical Modulation Transfer Function. Relative Differences Between Phase and Amplitude Filter.
	The first two reports have been reviewed and edited by and returned to approval. Work will be done on the third report during the next period.
25X1	For the next reporting period, the filter properties tests will be completed and work will start on the effect of the number of targets in one spatial filter. Work will continue on effect of shadows using 1 mm objects and the effect of target perspective. report, "Relative Differences Between Phase and Amplitude Filter" will be reviewed and edited.

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Automatic Image Recognition by Coherent Optical Techniques

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Progress Report No. 2

Financial Status

Amount Authorized

Estimated expenditures through 12 March 1965

Funds Committed

Funds Remaining

Technical Status

The engineering progress report for the period

5 February through 12 March 1965 is attached.

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Automatic Image Recognition by Coherent

Optical Techniques

Progress Report No. 2

Period Covered: 5 February to 12 March

Work has progressed in accordance to the PERT diagram submitted with Progress Report No. 1. We are on schedule at this point in the work program.

The simulated photographs have all been taken and spatial filters constructed for the majority. The results, particularly with the longer focal length optics on the 20-foot optical bench, have been quite good. The size of the object to be recognized and the focal length of the lenses employed can be related to give an equivalent "f" number. This number should be high; in the order of 400. Some of the images used with the shorter focal length bench have been large enough that they violate the "f-400" rule and recognition was poor. We have also observed the effect of dust and other particle matter as recognition is attempted of small low-contrast images. In general, particles create diffraction images which can block the recognition signal. The obvious solution is extreme cleanliness and careful handling of the film.

Experimental studies conducted during this period included the effects of glass plates in the optical system, effect of multiple targets, target perspective and shadows, recording materials study and filter location tolerance.

The experimental study of the effects of glass plates indicates that for larger image formats on glass plates, the optical flatness of ordinary plates is not adequate. Measurement of these differences in signal-to-noise will be postponed until the television readout can be employed to scan the entire plate and measurements move easily made.

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Work was completed on the use of photoplastic film as a filter recording medium. The results of this work indicates that photoplastic film is superior to other recording materials in that it provides a means for overcoming two operational problems.

- (1) rapid filter construction.
- (2) precise location of filter.

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For the next period tests will be continued on the effects of target perspective and shadows, and the study of the x - y displacement function will be completed. In addition, tests will be conducted on filter properties which include the effects of image scale and target orientation.